3.3.10 Weather - Severe Thunderstorms, Hail, Wind and Tornadoes

3.3.10.1 Background

A ***severe thunderstorm*** is a thunderstorm which produces tornadoes, hail 0.75 inches or more in diameter, or winds of 50 knots (58 mph) or more. Structural wind damage or damaged crops may imply the occurrence of a severe thunderstorm. A thunderstorm is approaching severe levels when it contains winds of 35 to 49 knots (40 to 57 mph) or hail ½-inch or larger but less than ¾-inch in diameter. Although not considered "severe", lightning and heavy rain can also accompany thunderstorms.

A ***chinook*** is a warm wind that develops down the east slopes of the Rocky Mountains. At times, these winds can reach several hundred of miles into the high plains.

High winds can also occur with strong pressure gradients or gusty frontal passages. These winds can affect the entire state with wind speeds in excess of 75-100 mph. Combined with snowfall or snow on the ground, high winds can cause blizzard conditions.

A ***tornado*** is a violently rotating column of air in contact with the ground and extending from the base of a thunderstorm. Until recently, tornadoes were categorized by the Fujita scale based on the tornado's wind speed.

The Enhanced Fujita (EF) Scale was implemented in place of the Fujita scale and began operational use on February 1, 2007. A comparison of the Fujita and EF scales and wind speeds are summarized in **Table 3.3.10-1.** The EF scale has six categories from zero to five representing increasing degrees of damage. It was revised to reflect better align wind speeds more closely with associated storm damage. It also adds more types of structures as well as vegetation, expands degrees of damage, and better accounts for variables such as differences in construction quality. The EF-scale is a set of wind estimates based on damage. It uses three-second estimated gusts at the point of damage. These estimates vary with height and exposure. Forensic meteorologists use 28 damage indicators (**Table 3.3.10-2**) and up to 9 degrees of damage to assign estimated speeds to the wind gusts.

Table 3.3.10-1 Comparison of Fujita and Enhanced Fujita Tornado Scale

Fujita Scale			Enhanced Fujita (EF) Scale		
Scale	**Wind Speed (mph)**	**Typical Damage**	**Scale**	**3-Second Gust Speed (mph)**	**Typical Damage**
F0	<73	Light Damage - Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.	EF0	66-85	Light Damage – Causes some damage to siding and shingles.
F1	73-112	Moderate Damage - Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.	EF1	86-110	Moderate Damage – Considerable roof damage. Winds can uproot tees and overturn single-wide mobile homes. Flagpoles bend.
F2	113-157	Considerable Damage - Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.	EF2	111-135	Considerable Damage – Most single-wide mobile homes destroyed. Permanent homes can shift off foundations. Flagpoles collapse. Softwood trees debarked.

Table 3.3.10-1 Comparison of Fujita and Enhanced Fujita Tornado Scale

Fujita Scale			Enhanced Fujita (EF) Scale		
Scale	**Wind Speed (mph)**	**Typical Damage**	**Scale**	**3-Second Gust Speed (mph)**	**Typical Damage**
F3	158-206	Severe Damage - Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.	EF3	136-165	Severe Damage – Hardwood trees debarked. All but small portions of houses destroyed.
F4	207-260	Devastating Damage - Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.	EF4	166-200	Devastating damage – Complete destruction of well-built residences, and large sections of school buildings.
F5	261-318	Incredible Damage - Strong frame houses lifted off foundations and swept away; automobile sized missiles fly through the air in excess of 100 meters.	EF5	>200	Incredible Damage – Significant structural deformation of mid- and High-rise buildings.

Source: NOAA-Storm Prediction Center, 2007

Table 3.3.10-2 Enhanced Fujita Scale Damage Indicators (DI)

DI No.	Damage Indicator	DI No.	Damage Indicator
1	Small Barns or Farm Outbuildings	15	Elementary School (Single-Story; Interior or Exterior Hallways)
2	One- or Two-Family Residences	16	Junior or Senior High School
3	Manufactured Home – Single Wide	17	Low-Rise Building (1-4 Stories)
4	Manufactured Home – Double Wide	18	Mid-Rise Building (5-20 Stories)
5	Apartment, Condo, Townhouse (3 stories or less)	19	High-Rise Building (over 20 Stories)
6	Motel	20	Institutional Building (Hospital, Government or University Building)
7	Masonry Apartment or Motel Building	21	Metal Building System
8	Small Retail Building (Fast Food Restaurant)	22	Service Station Canopy
9	Small Professional Building (Doctor's Office, Branch Bank)	23	Warehouse Building (Tilt-Up Walls or Heavy Timber Construction)
10	Strip Mall	24	Transmission Line Towers
11	Large Shopping Mall	25	Free-Standing Towers
12	Large, Isolated ("big box") Retail Building	26	Free Standing Light Poles, Luminary Poles, Flag Poles
13	Automobile Showroom	27	Tree – Hardwood
14	Automotive Service Building	28	Tree – Softwood

Source: NOAA-Storm Prediction Center, 2007

A thunderstorm is formed from a combination of moisture, rapidly rising warm air, and a force capable of lifting air, such as a warm and cold front or a mountain. All thunderstorms contain lightning. Thunderstorms may occur singly, in clusters, or in lines. Thus, it is possible for several thunderstorms to affect one location in the course of a few hours. Some of the most severe flooding from a thunderstorm occurs when a single thunderstorm affects one location for an extended time.

At any given moment, nearly 1,800 thunderstorms are in progress over the surface of the earth. On average, there are 100,000 thunderstorms each year in the U.S. Approximately 1,000 tornadoes develop from these storms. Straight-line winds are responsible for most thunderstorm damage.

Large hail results in nearly $1 billion in damage annually to property and crops in the U.S. Flash floods cause an average of 146 deaths each year in the U.S with lightning killing an additional 75 to 100 people on average.

Lightning is an electrical discharge that results from the buildup of positive and negative charges within a thunderstorm and the earth's surface. When the buildup becomes strong enough, lightning appears as a "bolt". This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning reaches a temperature approaching 50,000 degrees in a split second. The rapid heating and cooling of air near the lightning causes thunder.

Lightning's electrical charge and intense heat can electrocute on contact, split trees, ignite fires, and cause electrical failures. Approximately 10,000 forest fires are started each year by lightning, including dry thunderstorms common to Montana each summer. Approximately $100 million in annual losses result from forest and building fires caused by lightning.
Sources: TPO, 2004; NWS, 2004; FEMA, 2004; Curran and others, 1995.

3.3.10.2 History of Severe Thunderstorms, Hail, Wind and Tornadoes in Montana

The recording of weather events is highly dependent upon the public's observations and reporting to the National Weather Service. While weather stations are used to document wind speeds and precipitation, the spotting of tornadoes and assessment of hail stone size is often recorded based on a person's observations. These observations may be more accurate in populated areas where weather stations and other observations can verify extreme events. Rural areas may go under reported because of the fewer people that observe or witness the events. Reporting of extreme events may have also increased in the last 10 years because of better means to communicate storm events to the National Weather Service. As a result, records of storm events may indicate more frequent storms in recent history than in the past, a greater number of reports in populated areas versus rural areas, and more recent recording and documentation of losses related to severe thunderstorms

In Montana, most of the tornadoes occur in June, followed closely by the month of July. From 1950 to 2006, Montana had an annual average of six tornadoes. From 1950 to 2006, 97 of the 345 recorded tornado and funnel cloud events in Montana were considered F1 speeds or greater as recorded by the National Weather Service (2007). Montana had five deaths and at least 77 injuries from tornadoes from 1880 to 2006 (**Table 3.3.10-3**). The National Weather Service database indicates that from 1950 to 2006, severe summer weather has caused $69 million in property damage and $11 million in crop damage (**Table 3.3.10-4**).

Six deaths and 25 injuries were attributed to lightning strikes in Montana between 1950 and 2006 (**Table 3.3.10-4**). Based on historical storm data, hail and damaging winds are more likely to occur in Montana between 6:00 and 7:00 pm.

Table 3.3.10-3 Tornadoes Causing at Least One Death or Three Injuries in Montana (1880 to 2006)

Date	Event	Deaths	Injuries
May 15, 1883	Homes and other buildings destroyed at a mining community, eight miles south of Butte.	0	6
June 10, 1923	Two men killed by a falling tree as a tornado hit a copper mine near Rivulet in Mineral County.	2	0
June 15, 1924 2:30 pm	Three homes destroyed at a farming community northwest of Great Falls.	0	7
July 4, 1927 3:30 pm	Barns destroyed and livestock killed eight miles southwest of Suffolk, Fergus County.	0	6
May 22, 1933 6:00 pm	Ten buildings destroyed in Bainville, Roosevelt County. The injuries were in a cafe.	0	12
May 8, 1934 6:30 pm	A dozen homes unroofed and two service stations destroyed at Plentywood, Sheridan County.	0	7
June 27, 1936 2:30 pm	Seven injured by an F1 tornado in Blaine County.	0	7
June 7, 1946 2:00 pm	One killed and one injured by an F3 tornado in Roosevelt County.	1	1
September 16, 1946 5:15 pm	A small home destroyed near Sidney, Richland County.	0	8
July 19, 1952 3:30 pm	A large farm near the North Dakota border completely destroyed in Wibaux County.	1	2
July 10, 1965 5:15 pm	An F1 tornado injured 5 and caused $2.5 million in property damage in Choteau County.	0	5
July 9, 1983 6:37 pm	As the tornado passed near Vida, McCone County, it threw a car, with two people, for 200 yards.	1	1
July 20, 1993 5:30 pm	Two mobile homes destroyed in Rosebud County, two miles south of Lame Deer	0	3
August 14, 1999 4:15 pm	Two miles east of Lewistown	0	3
TOTAL		**5**	**68**

Source: TPO, 2007, NOAA-NCDC, 2007

Table 3.3.10-4 NOAA Severe Weather Summary (1950-2006)

TYPE	Dates	Number of Events	Fatalities	Injuries	Property Damage	Crop Damage
Dust Storms	1994-2006	6	1	11	$93,000	$500,000
Tornadoes (F1 or greater)	1950-2006	95	2	20	$23,070,000	$130,000
Hail (2 inches in diameter or greater)	1950-2006	304	0	2	$5,440,000	$1,575,000
Significant Lightning Events	1950-2006	42	6	25	$1,231,000	$3,000
Winds Events with at least one death	1950-2006	7	9	5	$260,000	$0
Wind Events with Recorded Property Damage	1950-2006	299	1	15	$39,155,000	$8,987,000
Total		**753**	**19**	**78**	**$69,249,000**	**$11,195,000**

Source: NOAA-NCDC, 2007

3.3.10.3 Declared Disasters from Severe Thunderstorms, Hail, Wind and Tornadoes

Disaster declarations for tornado and extreme wind and hailstorm events are shown in **Table 3.3.10.5**. No federal declarations have been made strictly for these categories of storms.

Table 3.3.10-5 Montana Disaster Declarations from Thunderstorms, Hail, Wind and Tornadoes (1974 through 2/2007)

Date	Event	Damages
July 23, 1997	Windstorm (EO 14-97). Disaster declaration for the City of Libby	State: $56,549 Local: $6,434
Sept. 5, 1997	Windstorm (EO 16-97). Disaster declaration for the City of Wolf Point	State: $13,833 Local: $3,994
June 23, 1999	Windstorm/Tornado (EO 7-99). Disaster declaration for the Town of Opheim	State: $10,366 Local: $296
August 14, 1999	Windstorm/Tornado (EO 11-99). Disaster declaration Fergus County and the City of Lewistown	State: $298,609 Local: $11,544
June 14, 2006	Windstorm (EO 35-06). Disaster declaration in the City of Glendive.	0
January 3, 2007	Windstorm (EO 01-07). Incident declaration to provide IA assistance to the Blackfeet Nation due to a wind event.	0

Source: MDES, 2007

3.3.10.4 Vulnerability to Severe Thunderstorms, Hail, Wind and Tornadoes

3.3.10.4.1 Statewide Vulnerability to Severe Thunderstorms, Hail, Wind and Tornadoes

In the case of severe thunderstorms, hail, wind, and tornadoes, the location and frequency of previous events are probably the best determiners of future events. Concentrations of these recorded events identify patterns of where they may likely occur in the future.

Table 3.3.10-6 shows the counties/tribal reservations with the highest frequency of tornadoes (F0 or greater as recorded from 1950 through 2006, hail events 2-inch diameter or greater (1955-2006), synoptic wind events of 75 mph or greater (1993-2006) and thunderstorm winds 75 mph or greater (1955-2006). The patterns of occurrence across the state for these events are shown on **Figures 3.3.10-1, 3.3.10-2**, and **3.3.10-3**.

Table 3.3.10-6 Counties with High Frequency of Tornadoes, Wind, and Hail Events

Tornados (≥ F0)		Hail (≥2-inch diameter)		Thunderstorm Wind (≥ 75 mph)		Synoptic Wind (≥ 75 mph)	
County	**#**	**County**	**#**	**County**	**#**	**County**	**#**
Valley	33	Valley	20	Yellowstone	34	Glacier	35
Fergus	28	Rosebud	19	Rosebud	25	Cascade	30
Yellowstone	17	Powder River	18	Custer	17	Wheatland	30
Roosevelt	15	Yellowstone	17	Powder River	16	Hill	26
Chouteau	14	Fergus	14	Broadwater	15	Teton	20
Powder River	14	McCone	12	Big Horn	11	Chouteau	19
Judith Basin	13	Phillips	11	Hill	11	Toole	19
Cascade	13	Garfield	10	Valley	11	Pondera	18
Dawson	13	Big Horn	10	Dawson	10	Lewis and Clark	18
Garfield	11	Carter	10	Garfield	9	Big Horn	17
Richland	11	Custer	10	Roosevelt	9	Liberty	15
Beaverhead	11	Lewis and Clark	9	Teton	9	Yellowstone	12

Source: NOAA-NCDC, 2007

Vulnerability to wind, hail, and tornado events can be measured as a function of the frequency and potential for property damage. Historic data on occurrence and estimated damages were compiled from National Weather Service records and provided through the National Climatic Data Center. Because hail, wind, and tornado events are often related, the frequency of a potentially damaging event was calculated for each county in any given year. For example, if the frequency is 200 percent, the county will have, on average, a potentially damaging event twice each year. The frequency for each type of event was summed to

provide a relative risk by county/tribal reservation. The counties with summed frequency in excess of 100 percent are listed in **Table 3.3.10-7** and shown on **Figure 3.3.10-4**.

Table 3.3.10-7 Composite Storm Index for Counties with Highest Vulnerability to Tornado, Extreme Wind, and Hail Damage

County	Tornado Frequency	Hail Frequency	Thunderstorm Wind Frequency	Synoptic Wind Frequency	Summary of Frequency
Cascade	22.81%	15.38%	28.85%	214.29%	281.32%
Glacier	5.26%	0.00%	3.85%	250.00%	259.11%
Hill	10.53%	3.85%	21.15%	185.71%	221.24%
Chouteau	24.56%	11.54%	9.62%	135.71%	181.43%
Big Horn	17.54%	19.23%	21.15%	121.43%	179.36%
Teton	7.02%	9.62%	17.31%	142.86%	176.80%
Fergus	49.12%	26.92%	11.54%	85.71%	173.30%
Lewis and Clark	10.53%	17.31%	5.77%	128.57%	162.17%
Valley	57.89%	38.46%	21.15%	42.86%	160.37%
Toole	12.28%	5.77%	5.77%	135.71%	159.53%
Pondera	0.00%	9.62%	3.85%	128.57%	142.03%
Liberty	7.02%	3.85%	5.77%	107.14%	123.78%
Judith Basin	22.81%	11.54%	9.62%	78.57%	122.53%
Custer	10.53%	19.23%	32.69%	50.00%	112.45%
Blaine	5.26%	5.77%	13.46%	85.71%	110.21%
Garfield	19.30%	19.23%	17.31%	50.00%	105.84%
Powder River	24.56%	34.62%	30.77%	14.29%	104.23%

Notes: Hail (2-inch diameter or greater) from 1955 - 2006
Tornadoes (F0 and greater) from 1950 - 2006
Thunderstorm wind events 75 mph or greater from 1955 - 2006
Synoptic wind events 75 mph or greater from 1993- 2006

3.3.10.4.2 Review of Potential Losses in Local PDM Plans

Figure 3.3.10-5 presents the Thunderstorm Wind-Hail-Tornado Hazard Risk Map. The colors represent a high-medium-low risk rating based on information in the Local PDM Plans. The gray color indicates this hazard was not assessed in the Local Plan. The hatch pattern indicates the Local Plans were not available for review. For electronic users of the State Plan, clicking on a county or tribal reservation will take you to the Local Plan where further information is available.

Figure 3.3.10-1 Reported Tornadoes (F0 or greater): 1950-2006

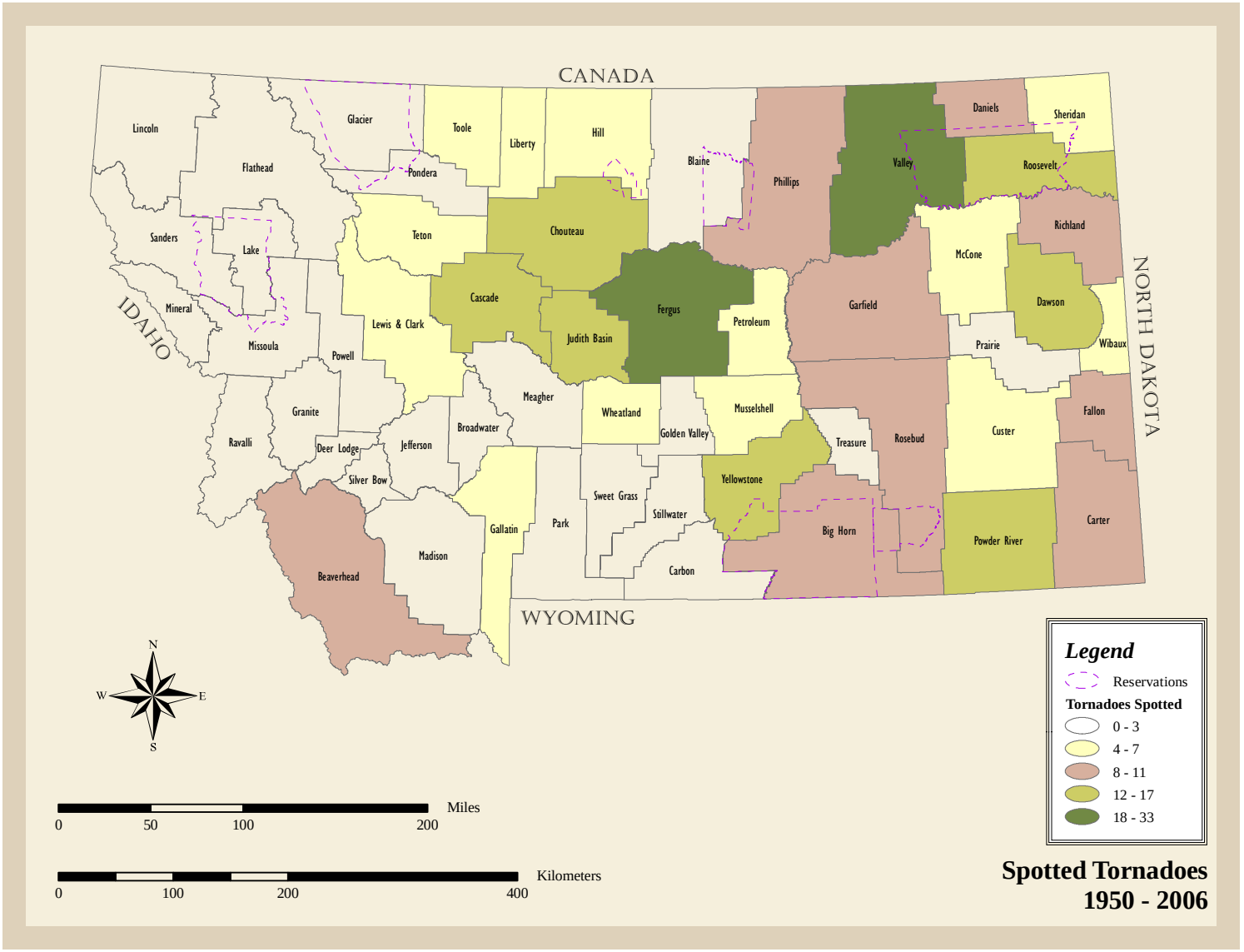

Figure 3.3.10-2 Hail Reports of 2 Inches or Greater 1955 – 2005

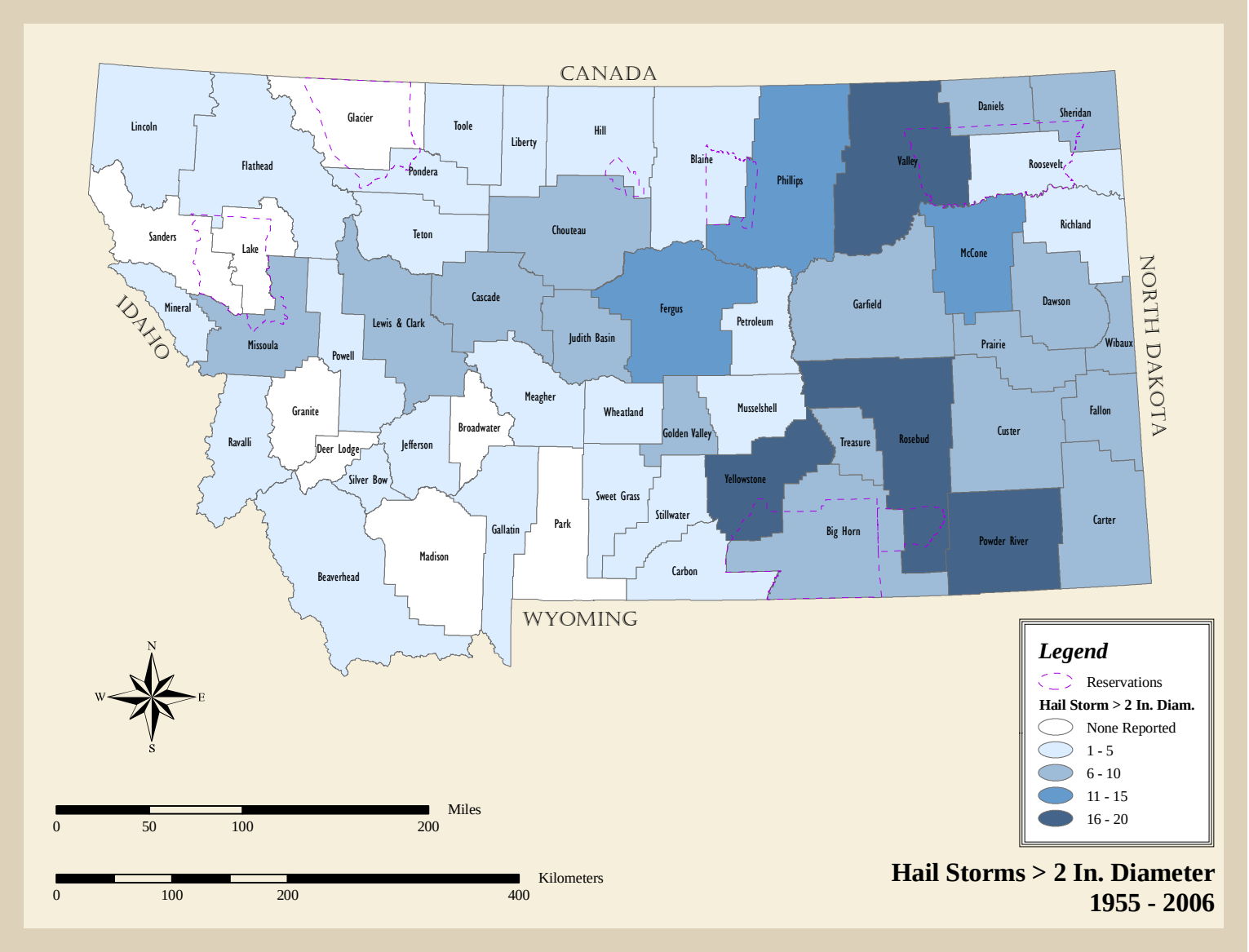

Figure 3.3.10-3 Frequent Wind Events (≥ 75 mph) 1993-2006

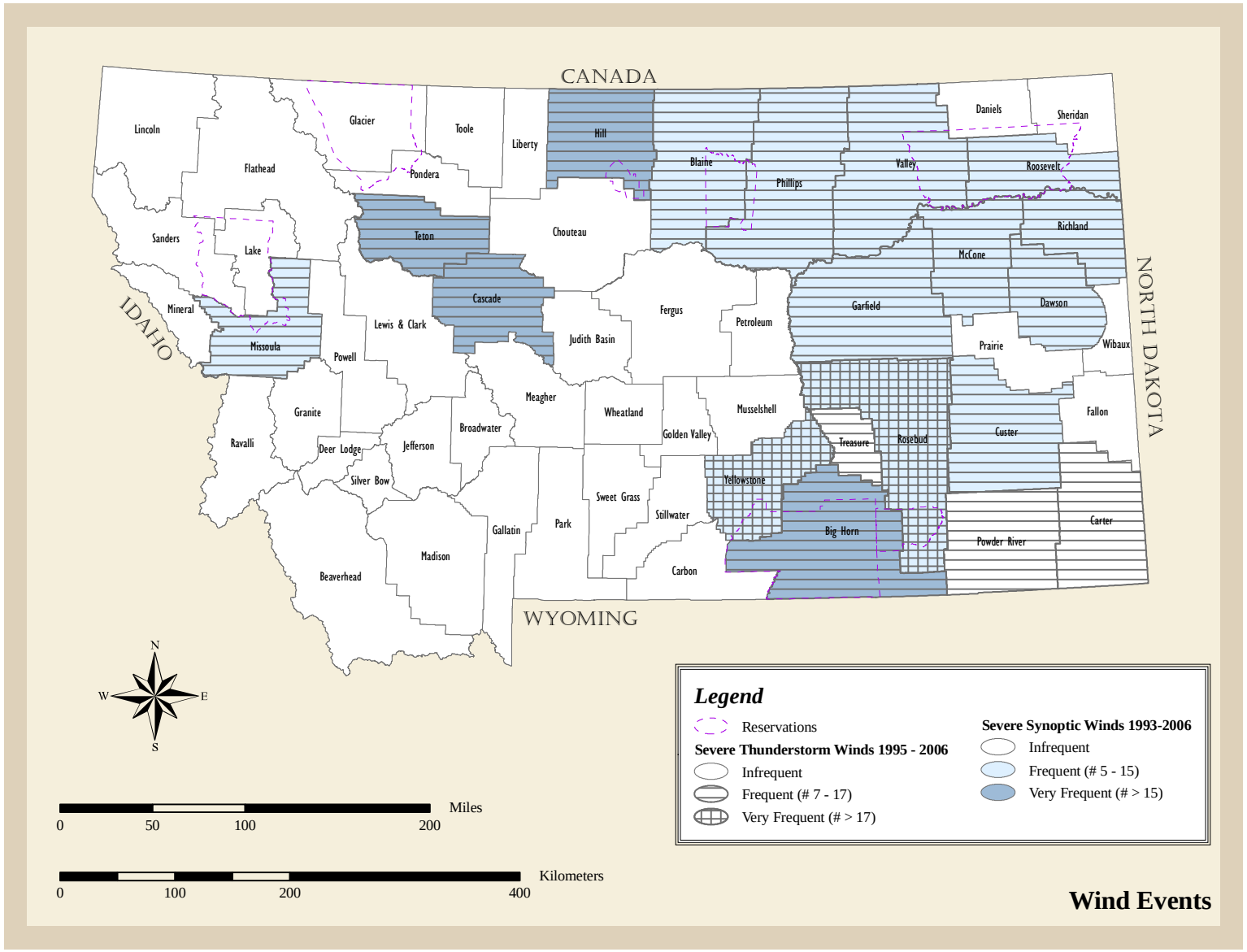

Figure 3.3.10-4 Tornado, Hail, and Wind Composite Frequency

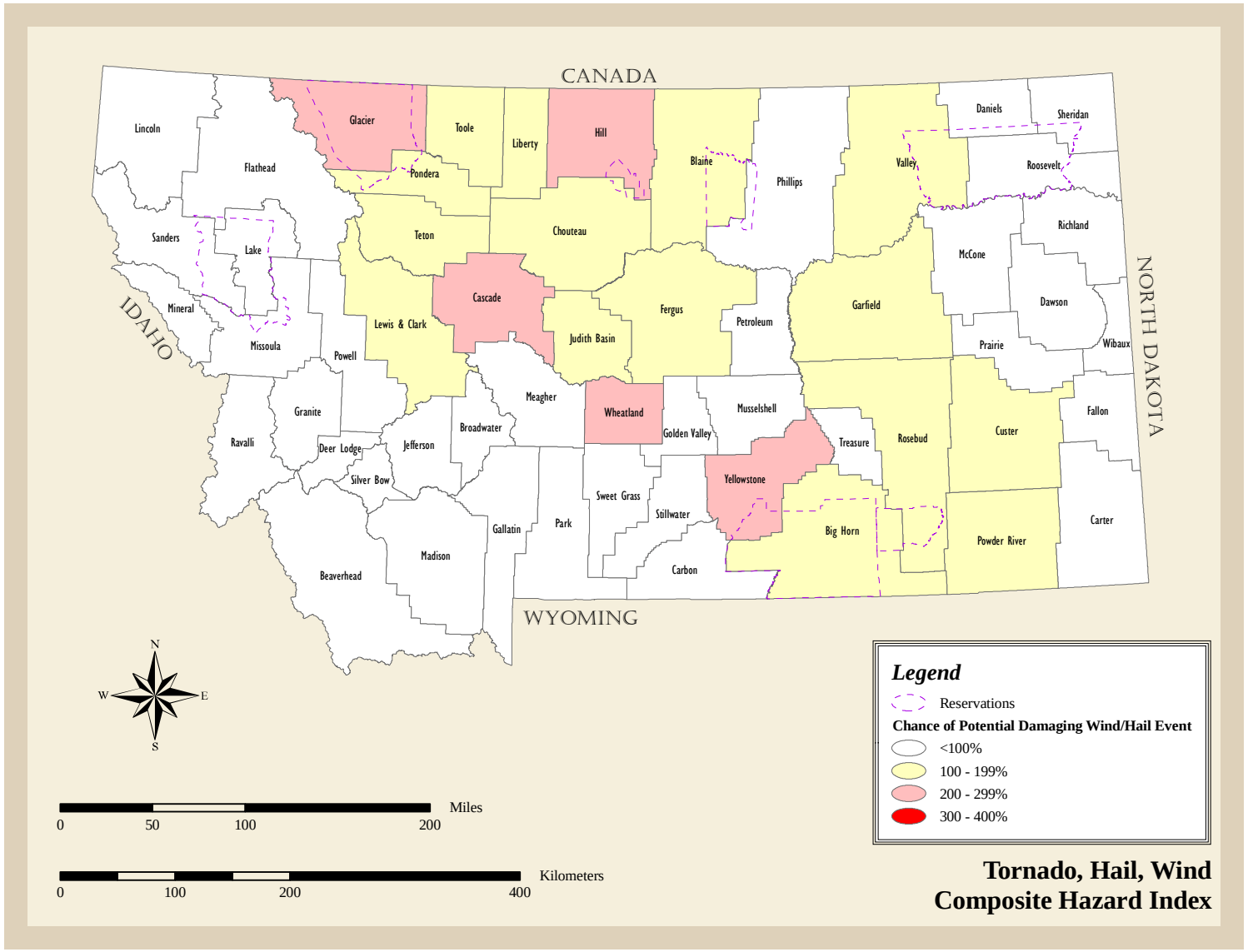

Figure 3.3.10-5 Hazard Risk Map: Thunderstorm, Hail, Wind and Tornado

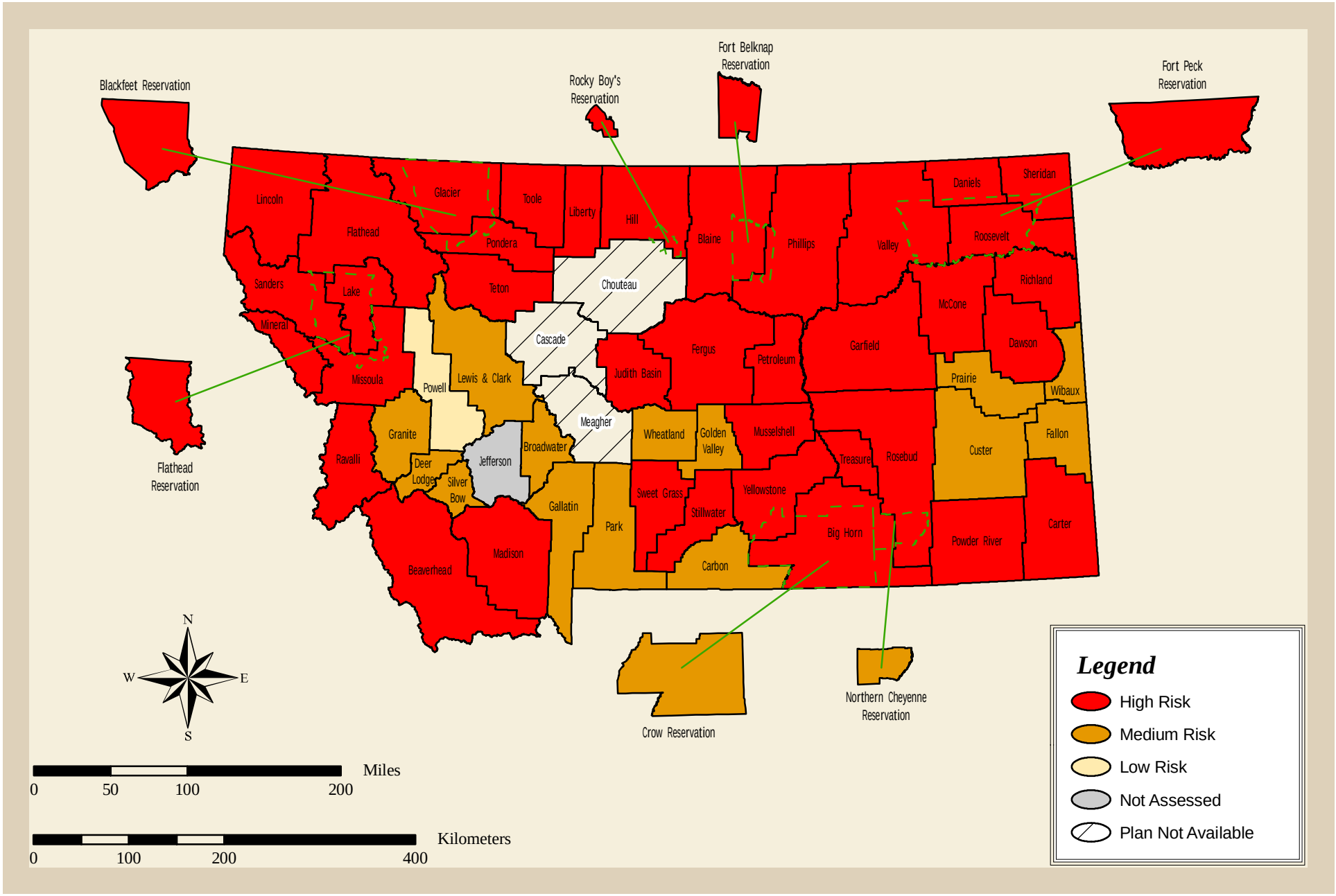

Table 3.3.10-8 presents a summary of potential loss estimates due to severe summer storms as calculated in the Local PDM Plans. Wind, hail and tornado loss is described in terms of its effect on buildings, society and the economy, where generally:

- Building loss is presented either as a dollar value or a high-moderate-low rating and typically refers to the potential loss to critical facilities in the jurisdiction.
- Societal loss is presented either as the number of lives at risk or as a high-moderate-low rating representing the potential for loss of human life.
- Economic risk is presented as a dollar value or high-moderate-low rating referring to the potential impact to the economy of the local jurisdiction.

References cited in **Table 3.3.10-8** correspond to a description of the method used to calculate potential loss that can be found in *Section 7.14.*

Table 3.3.10-8 Potential Losses from Local Plans: Wind-Hail-Tornadoes

DES District	Jurisdiction	Building Loss	Societal Loss	Economic Loss	Reference
1	Deer Lodge County	Moderate	Moderate	Low	1
1	Flathead County	$337,000	Moderate	Low	8
1	Flathead Reservation	NA	NA	NA	
1	Granite County	$352,000	Moderate	Moderate	1
1	Lake County	NA	NA	NA	
1	Lincoln County	NA	NA	NA	
1	Mineral County	$500,000-$1 million	High	NA	10
1	Missoula County	$500,000-$1 million	High	NA	10
1	Powell County	Medium	Medium	NA	10
1	Ravalli County	$500,000-$1 million	Moderate	NA	10
1	Sanders County	NA	NA	NA	
1	Silver Bow County	$337,000	Low	Low	1
2	Blackfeet Reservation	$122,666	3.3	NA	2
2	Blaine County	$1,242,927	24.5	NA	2
2	Cascade County	U	U	U	
2	Chouteau County	U	U	U	
2	Fort Belknap Reservation	$173,730	3.9	NA	2
2	Glacier County	NA	NA	NA	
2	Hill County	$3,363,667	60	NA	2
2	Liberty County	Medium	Medium	NA	11
2	Pondera County	NA	NA	NA	
2	Rocky Boy's Reservation	$393,027	11.3	NA	2
2	Teton County	NA	NA	NA	
2	Toole County	Medium	Low	NA	11
3	Beaverhead County	$18,500,000	477.6	NA	5
3	Broadwater County	$350,000	Moderate	Low	1
3	Gallatin County	Moderate	Moderate	Moderate	12
3	Jefferson County	NA	NA	NA	
3	Lewis & Clark County	NA	NA	NA	
3	Madison County	NA	NA	NA	
3	Meagher County	U	U	U	
3	Park County	Moderate	Moderate	Moderate	1

Table 3.3.10-8 Potential Losses from Local Plans: Wind-Hail-Tornadoes

DES District	Jurisdiction	Building Loss	Societal Loss	Economic Loss	Reference
3	Sweet Grass County	NA	NA	NA	
4	Carter County	Moderate	Low	Moderate	12
4	Custer County	Moderate	Moderate	NA	13
4	Dawson County	$1,000,000	NA	NA	8
4	Fallon County	$50,000	NA	Millions	8
4	Garfield County	$156,150	396	Moderate-High	1
4	McCone County	$1,600,000	Moderate	$500,000	3
4	Powder River County	$269,100	614	Moderate-High	1
4	Prairie County	NA	NA	Millions	3
4	Richland County	$500,000	Moderate	$1,000,000	3
4	Wibaux County	$250,000	Low	$250,000	3
5	Big Horn County	$500,000	Moderate	$500,000	3
5	Carbon County	$163,250	NA	NA	8
5	Crow Reservation	Hundreds of thousands	Moderate-High	Hundreds of thousand	3
5	Golden Valley County	$86,981	1.63	NA	2
5	Musselshell County	$492,134	8.81	NA	2
5	Northern Cheyenne Reservation	Hundreds of thousands	Moderate	Hundreds of thousands	3
5	Rosebud County	Moderate	Moderate	Moderate	1
5	Stillwater County	$440,000	NA	NA	8
5	Treasure County	Moderate	Moderate	High	1
5	Wheatland County	$255,124	4	NA	2
5	Yellowstone County	NA	NA	NA	
6	Daniels County	$239,501	3.5	NA	2
6	Fergus County	NA	4	7	4
6	Fort Peck Reservation	$2,813,364	70.4	NA	2
6	Judith Basin County	$286,000	3.3	NA	2
6	Petroleum County	NA	NA	NA	
6	Phillips County	$1,299,495	19.8	NA	2
6	Roosevelt County	$1,725,008	45.3	NA	2
6	Sheridan County	$572,642	8.4	NA	2
6	Valley County	$4,288,980	59.1	NA	2

Notes: U = Local PDM Plan not available for review; NA = not assessed in Local PDM Plan
Potential loss was computed was not computed in a uniform manner in Local PDM Plans. See number references in *Section 7.14* for a description of the methods used to calculate potential building, society and economic loss.

3.3.10.4.3 Vulnerability of State Property

State property that has suffered damage from extreme wind, hail, or thunderstorms is shown in **Table 3.3.10-9**. The claim record was only available for the period of July 1, 1999 through June 10, 2004.

Table 3.3.10-9 Loss Claims for State Facilities Caused by Extreme Weather (Hail and Wind)

Claim ID	Agency	Location	Cause of Loss	Date of Loss	Request	Indemnity
P2096	University System	Bozeman	Extreme Weather-Hail	7/3/1998	$25,000	$48,112
P-3496	DNRC		Extreme Weather-Hail	7/7/1998		$1,462
P-7547	Public Health		Extreme Weather-Hail	6/20/1999	$80,141	$101,904
P-11706	Transportation	Havre	Extreme Weather-Hail	6/8/2000		
P-13422	University System	Bozeman	Extreme Weather-Hail	6/30/2001	$4,077	
P-13283	Fish, Wildlife & Parks		Extreme Weather-Hail	7/22/2001	$2,200	
P-14519	University System	Bozeman	Extreme Weather-Hail	8/22/2002		
P-15612	Commerce		Extreme Weather-Hail	6/20/2003		
P-15292	Commerce		Extreme Weather-Hail	6/20/2003		
P-14176	Administration		Extreme Weather-Hail	1/6/2004		$45,489
P2847	University System	Billings	Extreme Weather-Wind	7/27/1998		$55,107
P-98-024	Transportation	Butte	Extreme Weather-Wind	12/26/1997		$8,142
P-2460	Fish, Wildlife & Parks		Extreme Weather-Wind	7/10/1998		
P-4579	Fish, Wildlife & Parks		Extreme Weather-Wind	11/27/1998		$785
P-5343	University System	Helena	Extreme Weather-Wind	2/3/1999	$63,000	$135,789
P-8163	Multiple Agencies		Extreme Weather-Wind	8/14/1999	$150,000	$150,992
P-9052	University System	Bozeman	Extreme Weather-Wind	9/24/1999	$2,500	$3,517
P-9152	Multiple Agencies		Extreme Weather-Wind	10/31/1999	$10,000	$42,404
P-8891	University System	Bozeman	Extreme Weather-Wind	4/4/2000	$3,000	$2,132
P-11581	University System	Bozeman	Extreme Weather-Wind	6/8/2000		$6,687
P-11637	University System	Bozeman	Extreme Weather-Wind	7/3/2000	$1,000	$16,220
P-11867	University System	Bozeman	Extreme Weather-Wind	9/1/2000		$12,704
P-12965	University System	Bozeman	Extreme Weather-Wind	4/20/2001		$24,651
P-13078	Corrections	Deer Lodge	Extreme Weather-Wind	5/5/2001		$20,637
P-13470	Corrections	Miles City	Extreme Weather-Wind	7/1/2001		
P-13201	Education	Great Falls	Extreme Weather-Wind	7/12/2001		
P-13548	University System	Bozeman	Extreme Weather-Wind	7/28/2001	$1,533	$533
P-13975	Livestock		Extreme Weather-Wind	4/14/2002		
P-14174	Corrections	Miles City	Extreme Weather-Wind	7/8/2002		
P-14603	University System	Missoula	Extreme Weather-Wind	7/13/2002		$11,215
P-14209	Transportation	Lewistown	Extreme Weather-Wind	7/14/2002		
P-14183	Transportation	Missoula	Extreme Weather-Wind	7/15/2002		$6,059
P-14455	Corrections	Miles City	Extreme Weather-Wind	8/16/2002		$650
P-14329	Fish, Wildlife & Parks		Extreme Weather-Wind	8/16/2002		
P-14327	Fish, Wildlife & Parks		Extreme Weather-Wind	8/16/2002		
P-15248	University System	Havre	Extreme Weather-Wind	6/20/2003		$149,000
P-15331	Transportation	Missoula	Extreme Weather-Wind	7/7/2003		
P-15607	University System	Bozeman	Extreme Weather-Wind	9/12/2003	$11,800	
P-15765	University System	Butte	Extreme Weather-Wind	10/28/2003		
P-15739	Education	Great Falls	Extreme Weather-Wind	11/19/2003		
P-15693	University System	Butte	Extreme Weather-Wind	11/19/2003		
P-16370	University System	Billings	Extreme Weather-Wind	7/7/2004		$4,297

Table 3.3.10-9 Loss Claims for State Facilities Caused by Extreme Weather (Hail and Wind)

Claim ID	Agency	Location	Cause of Loss	Date of Loss	Request	Indemnity
P-16374	Public Health	Glendive	Extreme Weather-Wind	7/11/2004		$2,977
P-16798	University System	Bozeman	Extreme Weather-Wind	12/20/2004		$20,762
P-16825	Environmental Quality		Extreme Weather-Wind	12/20/2004		$2,410
P-18060	Justice-Highway Patrol		Extreme Weather-Wind	6/14/2006		$3,113
P-18125	University System	Billings	Extreme Weather-Wind	7/11/2006		12,551
P-18310	University System	Missoula	Extreme Weather-Wind	8/7/2006	$1,646	$646
P-18230	University System	Bozeman	Extreme Weather-Wind	8/17/2006		$925
TOTAL					**$355,897**	**$891,872**

Source: DOA, Risk Management and Tort Defense Division, 2007

State-owned buildings that are considered to be highly vulnerable to tornadoes and extreme wind and hail events are those in counties that have a high frequency of the combined events. **Table 3.3.10-6** identifies the counties/tribal reservations with the greatest frequency of storms based on a matrix combining all types of tornado, wind, and hail storms. Those counties with highest vulnerability are considered those with a composite index greater than 200 or the jurisdictions that have had four or more recorded F1 or greater tornadoes. **Table 3.3.10-10** lists the counties and the State-owned facilities within those counties that are considered highly vulnerable to tornadoes, wind, and hail events.

Table 3.3.10-10 State Building Values in Counties Highly Vulnerable to Tornadoes, Wind and Hail Events

County	Frequency	Building Value	Contents Value	Total Value	State Employee Count
Pondera	456.10%	$1,530,202	$600,240	$2,130,442	57
Cascade	248.15%	$66,050,195	$18,126,565	$84,176,760	689
Wheatland	222.70%	$1,765,362	$226,965	$1,992,327	13
Teton	217.78%	$937,091	$505,692	$1,442,783	40
Lewis and Clark	213.51%	$326,386,470	$185,642,670	$512,029,140	4,946
Yellowstone	206.25%	$199,860,308	$75,459,200	$275,319,508	795
Glacier	205.88%	$1,807,706	$511,967	$2,319,673	53
Valley	176.14%	$2,940,021	$1,882,770	$4,822,791	113
Hill	159.50%	$90,009,648	$24,206,091	$114,215,739	101
Rosebud	133.31%	$1,509,336	$434,310	$1,943,646	36
Custer	129.62%	$31,324,507	$11,606,102	$42,930,609	302
Stillwater	111.59%	$497,276	$138,322	$635,598	36
Lake	98.02%	$10,924,908	$3,994,159	$14,919,067	120
Powder River	82.95%	$547,620	$182,908	$730,528	18
Totals		**$736,090,650**	**$323,517,961**	**$1,059,608,611**	**7,319**

Source: DOA, Risk Management and Tort Defense Division, 2007

3.3.10.5 Impact of Future Development

Future development will likely have little effect on the vulnerability to severe thunderstorms, tornadoes, or hail. The location of development does not increase or reduce the risk. Development and population growth may in fact improve the television and radio technology available to residents, and therefore, improve the warning capabilities (Gallatin County Hazard Mitigation Plan, 2006).

3.3.10.6 Severe Thunderstorms, Hail, Wind and Tornadoes Data Limitations

To effectively determine vulnerability of State property, data identifying locations of State buildings is necessary. The current Montana Department of Administration, Risk Management and Tort Defense PCIIS building database is not geo-referenced and cannot be effectively related to spatial coordinates except in general locations (by city or zip code centroid). In addition, the year built and structural stability are additional factors that would assist in assessing the vulnerability to state buildings.

National Weather Service data has improved significantly in the past decade, however, events are typically only recorded if observed by a weather station or reported to the local NWS office. In a state as rural as Montana, the data will therefore be somewhat dependent on event location (in a populated area versus an unpopulated area) and limited in that respect.

3.3.10.7 Severe Thunderstorms, Hail, Wind and Tornadoes References

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Tornado Project Online (TPO), 2007. http://www.tornadoproject.com/ http://www.tornadoproject.com/fujitascale/fscale.htm